Cricket Beacon Ring System

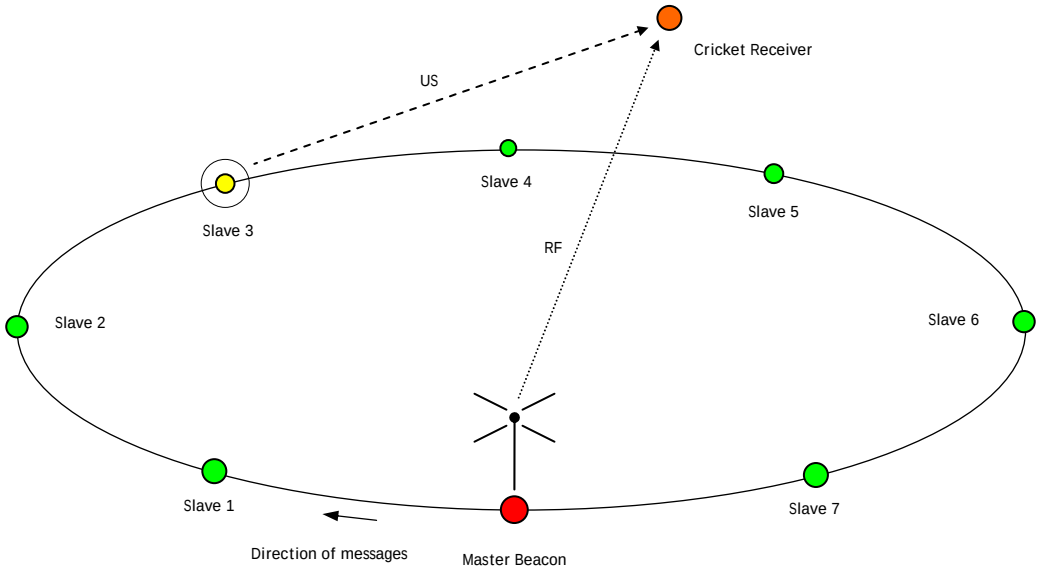

Fig. 1 - Beacon ring with Cricket receiver, master beacon, and 7 slaves

In the Cricket Beacon Ring system, a number of cricket beacons are arranged in a ring, where each beacon is connected to the previous and the next beacon. The beacon receives messages from one end, and transmits messages to the other end.
The master beacon transmits periodic messages to the first slave. This message consists of only one byte, being the number of the target slave. When a slave receives a message, it checks the value of this byte. If the value is zero, it is simply passed on without further action. When the value is greater than zero, it is decremented and then passed on. When the result value is zero, the slave beacon transmits a ultrasound burst.
The master beacon will eventually receive the message it transmitted. When the value of the received message is zero, it means that it has reached its target. When the value of the message is greater than zero, the difference in value from the transmitted message is equal to the number of slaves in the ring. If there is no message received at all, the ring is broken.

In a beacon transmit loop, the master will send a message starting with value of one, and waits until it is received at the other end. If the value of the received message is zero, the master will transmit a new message with a value one higher than the previous message. If the value of the received message is non-zero (typically one), it will start again with a message of one. This way all targets in the ring will be triggered in turn and transmit their ultrasound burst.

After sending each message, the master itself will transmit a RF burst containing the value of the transmitted message, which equals the target slave number. The transmission of the RF burst is delayed to equal the propagation delay of the message until received by the target. This propagation delay is directly proportional to the target address, and dependant on the transmission bit rate. This way the RF transmission will always be synchronous with the ultrasound burst of the target slave.

The Cricket receiver will be triggered upon reception of the RF signal, and extract the slave address from it. It will then time the arrival of the ultrasound burst, and calculate the distance to the active beacon.

After each distance measurement, the Cricket receiver will update its estimated position and velocity using an Extended Kalman Filter. Successive distance measurements will continuously improve the accuracy of the estimate, using the best available information.